**Biodiesel: Overview Presentation**

* Major Characteristics
  + Definitions/Key Terminology
    - According to the National Biodiesel Board, the general definition of biodiesel is a domestic, renewable fuel for diesel engines derived from natural oils like soybean oil, and which meets the specifications set by the American Society for Testing and Materials
    - The more technical definition of biodiesel is a fuel comprised of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats
    - Biodiesel is made through a chemical process called [transesterification](http://www.biodiesel.org/pdf_files/fuelfactsheets/Production.PDF) whereby the glycerin is separated from the fat or vegetable oil. The process leaves behind two products -- methyl esters (the chemical name for biodiesel) and glycerin (a valuable byproduct usually sold to be used in soaps and other products)
  + Major Grades/Blends
    - Pure biodiesel can be blended with petroleum-based diesel fuel, much like ethanol can be blended with petroleum-based gasoline
    - The blends are designated Bxx, or B followed by the percentage of biodiesel contained in the fuel
    - B100 is pure biodiesel
    - The most common blends are B2, B5, B20, and B100
    - In March of 2002, Minnesota enacted the nation’s first biodiesel mandate that required nearly all biodiesel sold in the state to contain at least 2% biodiesel starting in 2005. The mandate is now 5% and will increase to 10% in 2012, and 20% in 2015 (though the B10 and B20 mandates will be seasonal from April through October because one of the drawbacks of biodiesel is that it gels up at warmer temperatures than petroleum-based diesel) (http://www.truckline.com/AdvIssues/Energy/RENEWABLE%20DIESEL%20%20BIODIESEL/State%20Biodiesel-Renewable%20Diesel%20Mandates\_Updated%20January%202010.pdf)
    - Oregon, Washington, and Massachusetts also have biodiesel mandates of at least B2, and other states are in the process of setting similar mandates. (truckline.com)
    - Blends up to B20 can be used in diesel engines without modification to the engine or fuel system in vehicles made after 1993. Vehicles made before then may possibly need slight modifications because biodiesel tends to soften and degrade elastomers and rubber compounds found in the vehicle hoses and seals. (NBB)
  + Market Size/Make-up
    - The biodiesel market is currently significantly smaller than the ethanol market: approximately 80 per cent of the biofuels market represents ethanol and 20 per cent biodiesel (http://www.unctad.org/en/docs/ditcbcc20091\_en.pdf)
* Global capacity rose from 2.2 million tons per year in 2002 to 29.6 million tons per year in 2008, and production rose from 1.8 million tons per year in 2002 to 10.8 million tons in 2008. So, global production and capacity are growing rapidly. However, high prices and feedstock shortages in Europe, the US, and Asia are the major contributors to the increasing gap between capacity and production. (http://www.unece.lsu.edu/biofuels/documents/2010Aug/bf10\_16.pdf)
  + - Europe produces and consumes over 80% of biodiesel worldwide, with Germany producing over half of that (making it the world-leading producer). The US produces about 7%, and the rest of the world produces about 8%.
    - In July of 2009, a duty was added to American imported biodiesel in the European Union in order to balance the competition from European, especially German producers. (?)
  + Only 3% of all cars on U.S. roads run on diesel. However, more than 80% of all commercial trucks and major bus networks in municipal areas are diesel based. That, more than anything else, suggests a huge potential market for this fuel in the world's most energy-hungry nation. (BFF)
  + There is a relatively small U.S. market for diesel in passenger cars compared with Europe (where more than 50% of all cars run on diesel), China, and India where diesel is the dominant on-road fuel for passenger cars. However, the U.S. market share of diesel cars is also expected to grow, from 3% in 2005 to 11% by 2010. (BFF)
* Production/Consumption Statistics
  + Production Regions
  + Import/Export Markets
* Competitive Landscape
  + Major Producers
  + Industry Concentration
  + Competing Products
* Global Trends
  + Mandatory blends and utilization targets have played an essential role in the development and expansion of the biofuels sectors of the two major producers, Brazil and the United States.
  + We estimate that current and expected blending targets will increase global demand for biodiesel to 88 billion litres (23.2 billion gallons), while total production capacity will be around 34 billion litres (9 billion gallons).
  + In the United States the target is expressed as a specific volume of biofuels utilization that needs to be achieved (36 billion gallons in 2022, for example), while in the EU the target is a percentage of the transportation fuels demand that needs to be supplied by biofuels (5.75 per cent by 2010)
  + The approach followed by the United States and the EU does not require that a particular blend be made available to the market. The biofuel content can change throughout the year as it responds to short-term changes in the supply and prices of biofuels and fossil fuel products.
  + Countries such as Argentina, China and Malaysia, which have programmes to stimulate the use of biodiesel, will present a combined demand similar to that of the United States
  + Brazil is already a key player in the biodiesel market; other developing countries are expected to consolidate their position and expand exports to the EU, the United States and other countries.
  + Chinese biodiesel production is at a very early stage of development in part because biodiesel feedstocks are in short supply. The government has only recently decided to actively support the industry, trialing non-traditional biodiesel crops such as jatropha
  + The EU is currently the main producer of biodiesel: production has increased more than sixfold between 2000 and 2006 (this and all above from BM&CS)
  + From 2006 to 2020, the global energy market is expected to grow at about 1.5% per year on average, with higher or lower projections depending on which energy expert, government forecast, or think tank report you read. The U.S. energy market is expected to grow at 1.7% per year to 2020, while Europe will grow at a slightly slower rate (1.3%). Estimates for growth in the Chinese energy market range from 3.8% to 8% per year to 2020; for India, 3%; and Brazil, 3% to 4% (BBF)
  + In Europe and in the United States, the markets have a long way to grow to reach these targets. Though Europe reached its first target, 2% by 2005, achieving its next targets (5.75% by 2010 and 20% by 2020) will depend on feedstock availability, government commitment, and market economics. Using current consumption figures, Europe would need to replace approximately 3 billion gallons by 2010 and 20 billion gallons by 2020. (BBF)
* Pricing Trends

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| **Table 1. Overall Average Fuel Prices** *Nationwide Average Price for Fuel This Report* | | *Nationwide Average Price for Fuel Last Report* | | *Change in Price This Report vs. Last Report* | | *Units of Measurement* | |
| Gasoline (Regular) | $2.71 | | $2.84 | | ($0.13) | | per gallon |
| Diesel | $2.95 | | $3.02 | | ($0.07) | | per gallon |
| CNG | $1.91 | | $1.90 | | $0.01 | | per GGE |
| Ethanol (E85) | $2.30 | | $2.42 | | ($0.12) | | per gallon |
| Propane | $2.90 | | $2.89 | | $0.01 | | per gallon |
| Biodiesel (B20) | $3.06 | | $3.12 | | ($0.06) | | per gallon |
| Biodiesel (B99-B100) | $3.75 | | $3.57 | | $0.18 | | per gallon |

* + B20 prices are higher than regular diesel by about 11 cents. B99/B100 blends have a cost of about 80 cents per gallon more than regular diesel (http://www.afdc.energy.gov/afdc/pdfs/afpr\_jul\_10.pdf)

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| **Table 2. April 2010 Overall Average Fuel Prices on Energy-Equivalent Basis** *Nationwide Average Price in Gasoline Gallon Equivalents* | | *Nationwide Average Price in Diesel Gallon Equivalents* | | *Nationwide Average Price in Dollars per Million Btu* | |
| Gasoline | $2.71 | | $3.03 | | $23.52 |
| Diesel | $2.65 | | $2.95 | | $22.94 |
| CNG | $1.91 | | $2.13 | | $16.57 |
| Ethanol (E85) | $3.25 | | $3.63 | | $28.19 |
| Propane | $4.01 | | $4.47 | | $34.77 |
| Biodiesel (B20) | $2.79 | | $3.11 | | $24.18 |
| Biodiesel (B99-B100) | $3.69 | | $4.12 | | $31.98 |

* + Because of differing energy contents per gallon for these fuels, the price paid per unit of energy content can differ somewhat from the price paid per gallon. Table 2 illustrates the fuel prices from Table 1 for the current reporting period normalized to a price per gasoline gallon equivalent (GGE), per diesel gallon equivalent (DGE), or per million Btu of energy.
  + Note that prices for the alternative fuels in terms of cost per gallon equivalent are generally higher than their cost per gallon because of their lower energy content per gallon (2010 Price Report)
* Supply Chain Dynamics
  + Figure 6.1. Prices of vegetable oils used to produce biodiesel from 1996/1997 to 2016/2017



* Future Outlook of Production/Market Health and Key Factors
  + One way to forecast possible developing country actors in the second generation biofuel sector is to identify those countries that have the current capacity to produce biofuels and possibly become early movers in the emerging technologies. The Ernst and Young Biofuels Country Attractiveness Indices, ranking the attractiveness of global markets for investment in biologically derived renewable fuels, which include both ethanol and biodiesel, are a useful proxy (BM&CS)
  + Table 5.2. All Biofuels Index at Q4 2007 (in parenthesis is ranking in Q3 2007)

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| **Ranking** | **Country** | **All Biofuels** | **Ethanol** | **Biodiesel** | **Infrastructure** |
| 1 (1) | USA | 75 | 80 | 69 | 86 |
| 2 (2) | Brazil | 71 | 75 | 67 | 94 |
| 3(4) | Germany | 60 | 65 | 60 | 81 |
| 4 (3) | France | 59 | 64 | 56 | 67 |
| 5 (5) | Spain | 57 | 60 | 55 | 60 |
| 5 (6) | Canada | 57 | 59 | 53 | 72 |
| 7 (9) | Thailand | 53 | 56 | 50 | 47 |
| 7 (11) | China | 53 | 56 | 50 | 47 |
| 9 (7) | UK | 52 | 55 | 49 | 56 |
| 10 (8) | Sweden | 51 | 54 | 48 | 66 |
| 10 (11) | Colombia | 51 | 54 | 48 | 50 |
| 10 (11) | India | 51 | 53 | 48 | 50 |
| 13 (14) | The Netherlands | 48 | 50 | 48 | 48 |
| 13 (9) | Italy | 48 | 49 | 47 | 47 |
| 13 (-) | Philippines | 48 | 48 | 47 | 46 |

* Biodiesel still represents a small share of the total biofuels market, but biodiesel production is expected to grow quickly, as demand is expected to grow at a faster rate than demand for ethanol (BM&CS)
* Although Europe currently represents 90% of global biodiesel consumption and production, the United States is now ramping up production at a faster rate than Europe, and Brazil is expected to surpass U.S. and European biodiesel production by 2015. It is possible that biodiesel could represent as much as 20% of all on-road diesel used in Brazil, Europe, China, and India by 2020. (
* By 2015, as energy demands for soybean, canola, and jatropha oil surpass the available land to plant these energy-rich crops, alternative feedstocks such as palm oil and algae-based biodiesel will help to meet growing demands. The U.S. National Renewable Energy Lab forecasts that soybean and canola-based biodiesel will only be able to supply 10% of the total market for energy needs in the United States. However, new feedstocks such as algae-based biodiesel will go into mass production in the United States and could provide 30% or more of all transportation energy needs from biodiesel by 2020. Algae is one of the most promising alternative biodiesel feedstocks and could produce more than 10 times more oil per acre than soybeans or canola. (BFF)
* Major Market Segments
  + Geographic
  + End-user Demographics